

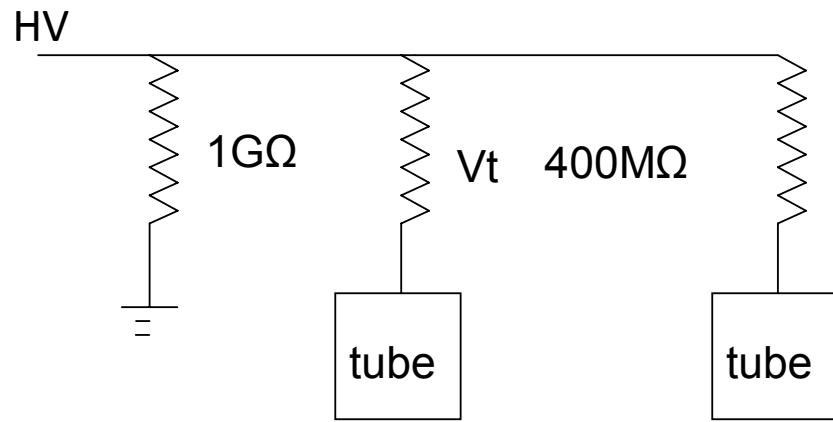
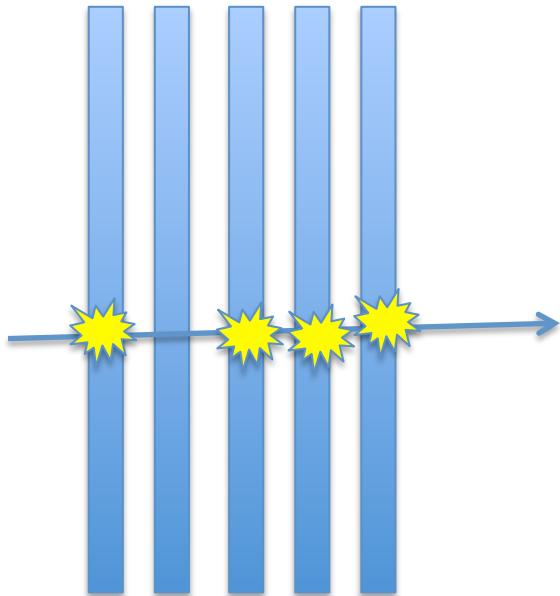
MUID Efficiency HV Method

Itaru Nakagawa

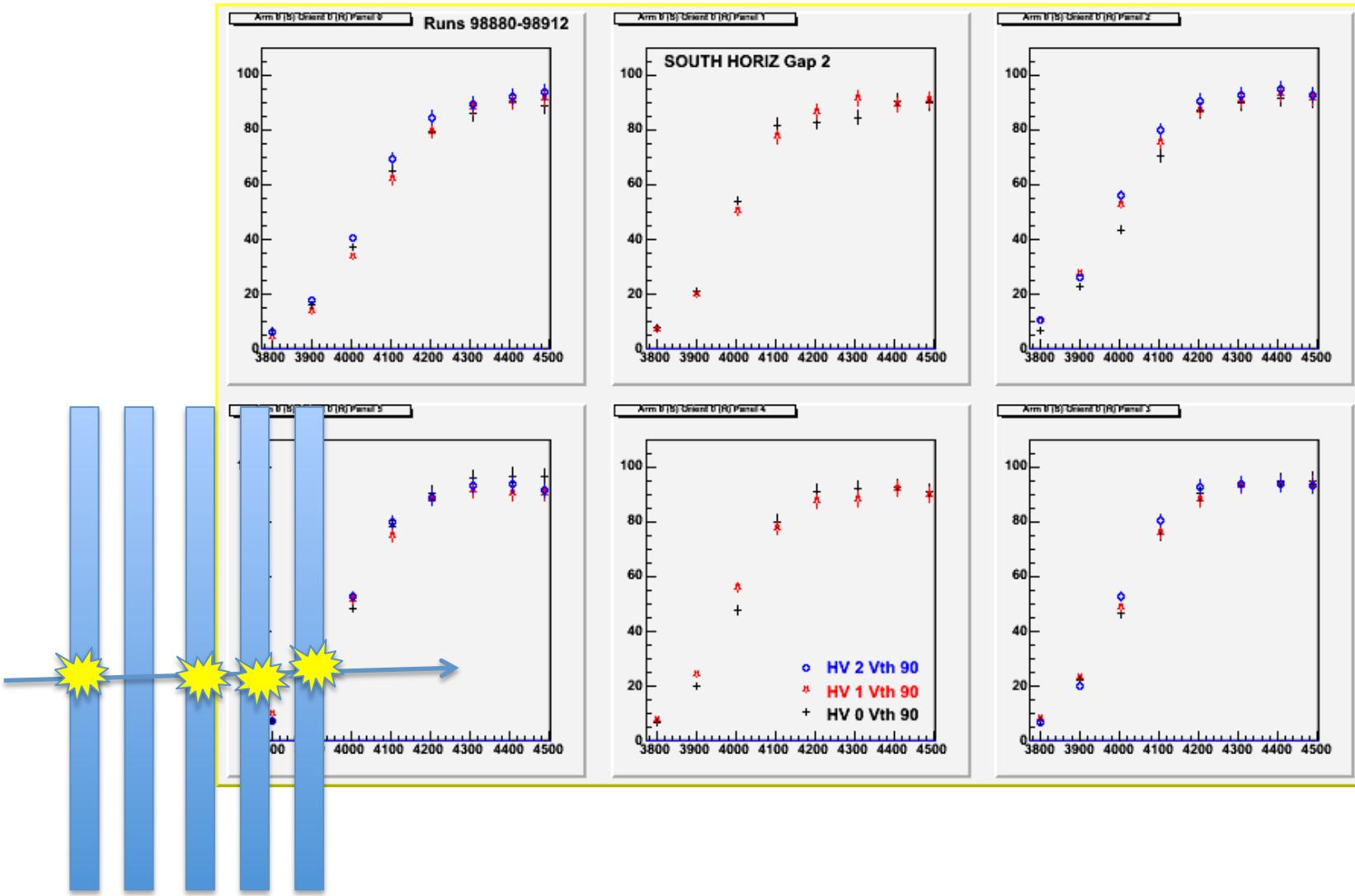
RIKEN

Two Different Ways of Efficiency Evaluation

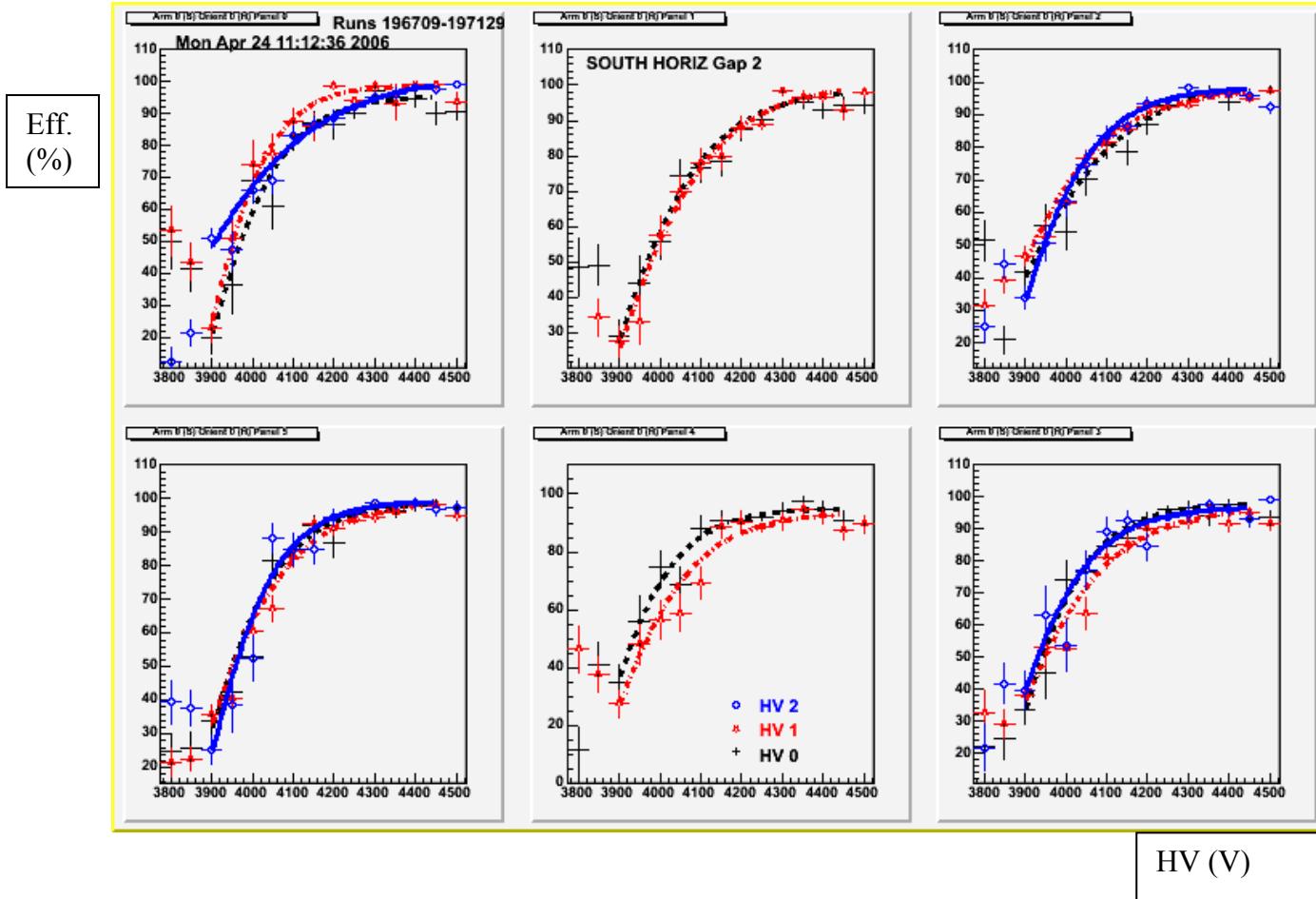
1. Data Driven
2. HV Method



HV Scan with Cosmic Ray (2004)



MUID Eff vs. HV Empirical Formula



$$E = 0.96 (1 - 2.4e-6 V_S^2)$$

Data Driven Method vs. HV Method from Run5

Analysis Note 501

Two methods are consistent!

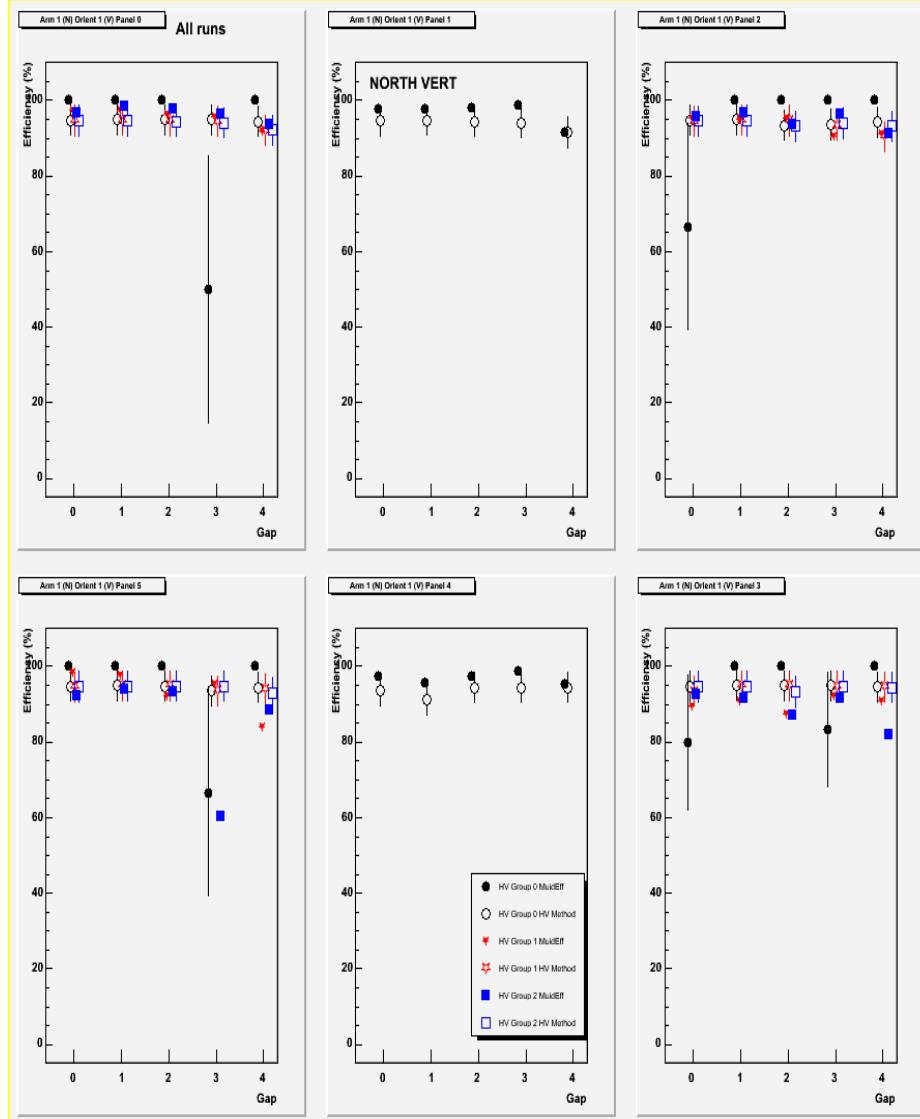


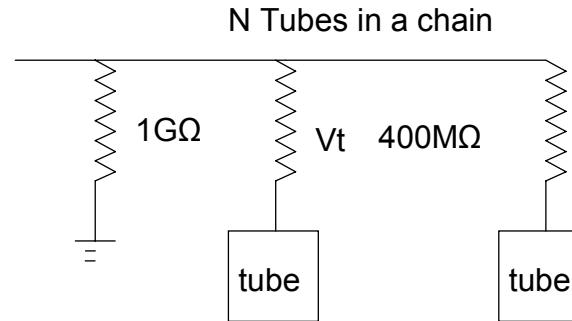
Figure 2.12: Run-5 Copper-Copper South Arm Vertical MUID Efficiencies from DataMethod and HVMethod for the six panels, different HV groups and as a function (x-axis) of gap number.

Voltage Sagging

MUID HV Algebra

Overall Resistance with n broken wires
(2.5 factor is from 1 / 0.4) :

$$R_n = \frac{1G\Omega}{(1+2.5n)}$$



=> Current draw with n broken wires [normal : n=0; 4.4 kV & 4.4 μA]:

$$I_n \text{ (in } \mu\text{A)} = (1+2.5n) V \text{ (in kV)}$$

Extra current over the basic current draw gives HV sag a la:

$$V_s \text{ (in kV)} = \frac{I_{\text{extra}} \text{ (in } \mu\text{A)}}{(N - n)}$$

[5μA extra current => ~100 V sag and potentially noticeable eff. loss]

$$Vs = I_{\text{extra}} / (\# \text{of tubes}) \times 400 \text{ Mohm}$$

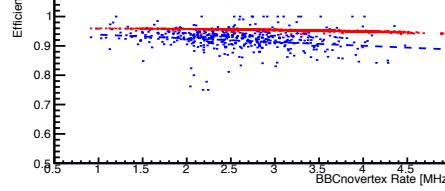
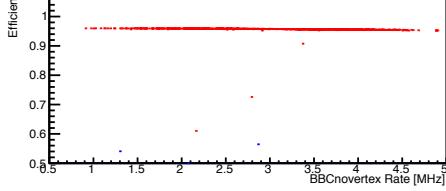
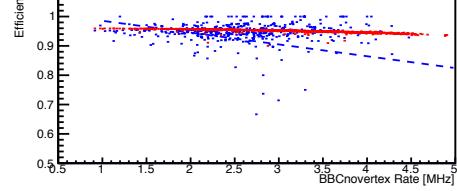
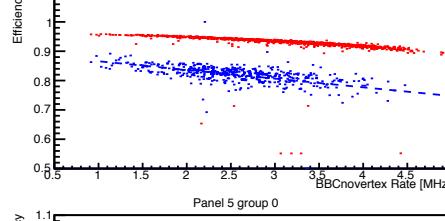
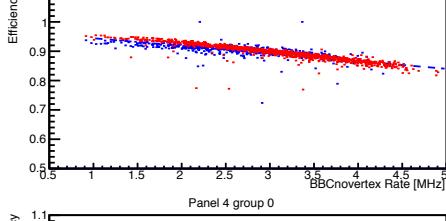
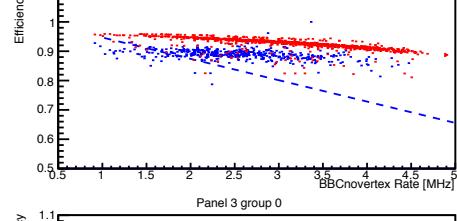
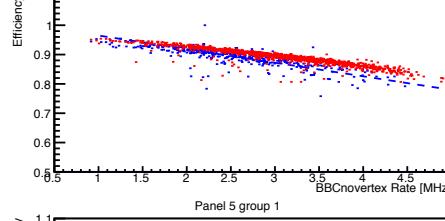
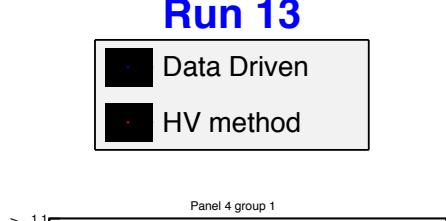
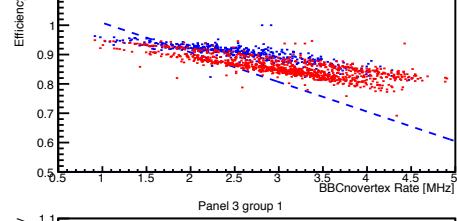
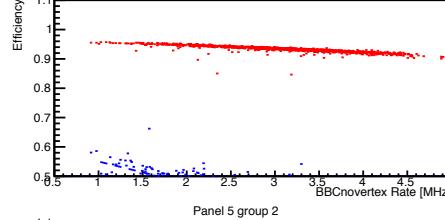
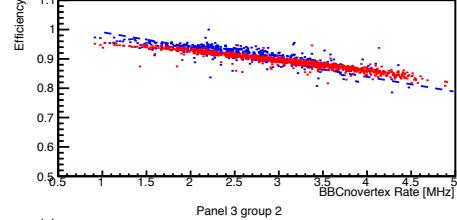
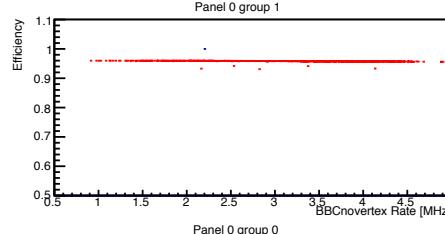
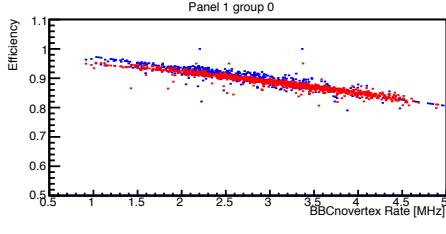
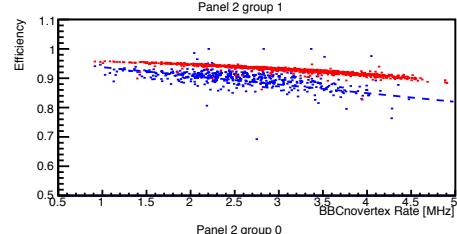
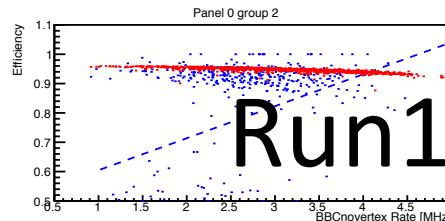
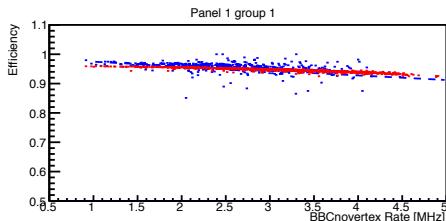
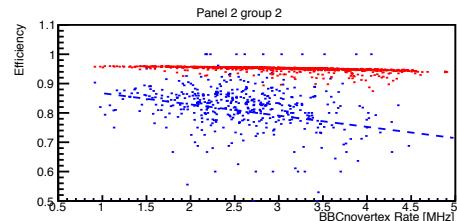
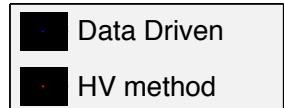
$$\sim 5\mu\text{A}/20\text{tubes} \times 400 \text{ [Mohm]} = 0.25 \text{ [\mu A/tube]} \times 400 \times 10^6 \text{ [ohm]}$$
$$= 100 \text{ [V]}$$

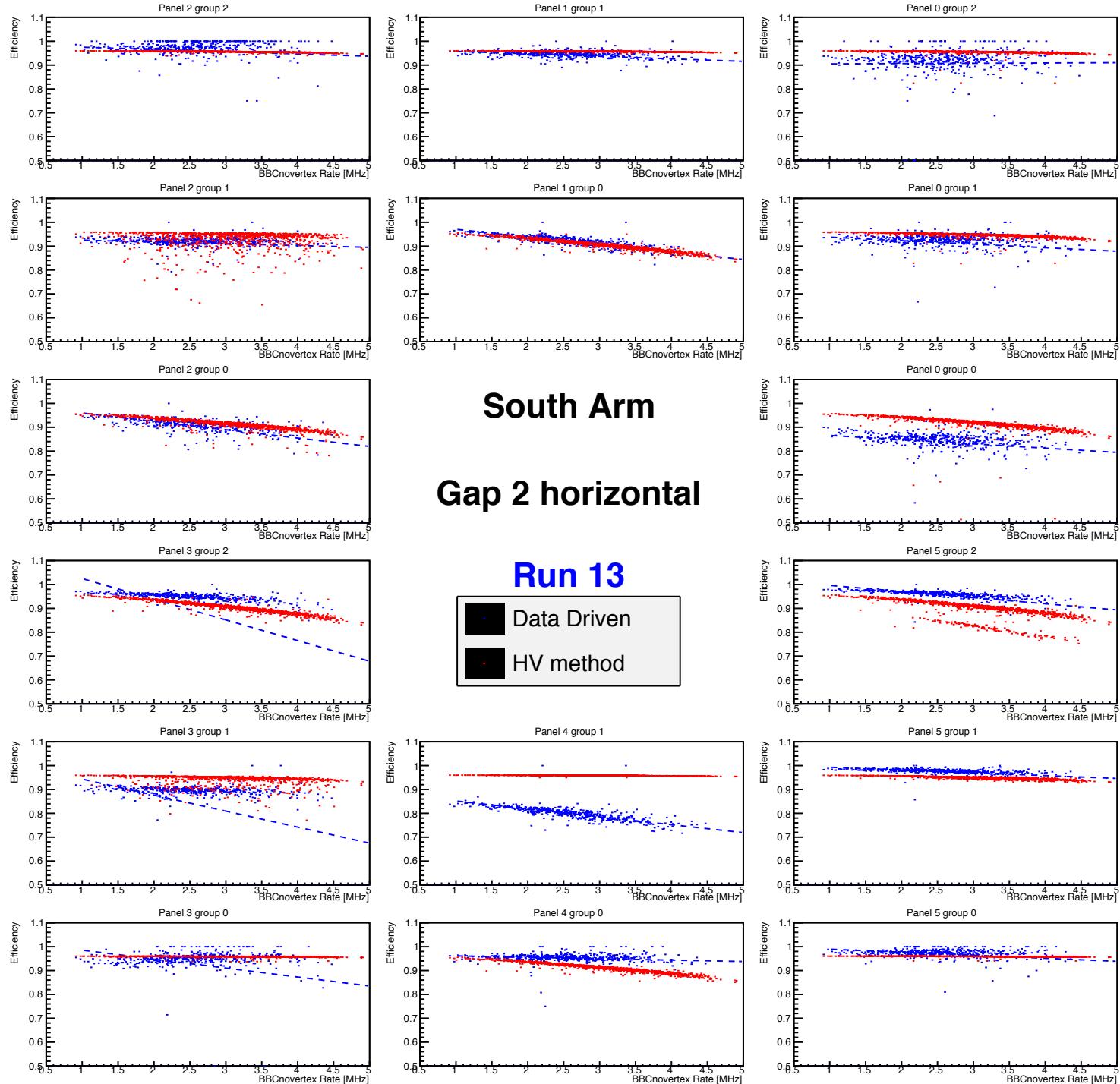
Run13 Results

South Arm

Gap 1 horizontal

Run 13





What Could be Different?

	Data Driven	HV Method
Current Draw	Instantaneous Current ($\varepsilon \rightarrow \text{Low}$)	Average Current
Track Rate Dependence	Biased to higher rate ($\varepsilon \rightarrow \text{Low}$)	Average
Efficiency \sim Current		Assumes all tubes behave same response. Formula is 10 years old. May be degraded by now. ($\varepsilon \rightarrow \text{Low}$)

These Effects becomes increasingly enhanced with higher rates.

Task Lists for HV Scan

- Big partition or Standalone.
- Activate HV log database (ask Martin) dump HV values for every run.
- Trigger : MUID-LL1 may or may not works. If not, need to setup Blue Logic Trigger which hasn't been used for several years.
- HV scan script
- Analysis software (Quick efficiency calculation by data driven method) -> Ask MUID experts if there is.
- Execution clue
- Analysis man power

HV control script

1. Change HV value of the interest plane
2. Read Back from HV frame and dump the HV values and timestamp.
3. If database is running, then 2. is not necessary.

Data Taking Procedure

- Change HV setting (script)
- Change Trigger configuration
- Take data. 1M triggers (15 minutes assuming rate \sim 1kHz)
- 10 HV setting \times 5 gaps = 50 runs.

- (2013/06/22 0:18), Cianciolo, Vince wrote:
Hi Itaru –

The HV method will not necessarily predict lower efficiencies than the data method.

My understanding is that the HV method works in the following way:

- 1) Determine the difference between the measured current w/ beam on and the baseline current for each chain.
- 2) Divide by the number of tubes in the chain to get the average current.
- 3) Multiply by the input impedance (400 M-ohm) to get the voltage drop; subtract from 4400 to get the effective tube voltage
- 4) Use the old efficiency vs. voltage curves to estimate the efficiency.

Let's say that we measure 20 uAmps in a chain. That would be 1 uAmp on a tube, corresponding to a 400 V drop. I don't remember quantitative values, but I'd guess this would reduce the efficiency to nearly 0.

I don't know what hit rate 20 uAmps/chain corresponds to and I don't remember how wide the signals are. Let's say (just as an example) that that the hit rate to get that current is 1 MHz/tube and that the signals are 100 ns wide. In that case, there would be a 10% dead time.

The data method should correctly see the 10% dead time, but the HV method would predict a much lower efficiency.

I don't know this is true, but wanted to present it as an example.

If you can show that the efficiency drop linear in hit rate it would definitely imply the deadtime model, and you could also extract the effective dead-time for a hit.

Cheers,
Vince

The unit of recorded current in database is [uA].